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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/756,019	01/05/2001	Evelyn Duesterwald	10990961-1	3721

7590 12/17/2003

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EXAMINER	
ROCHE, TRENTON J	

ART UNIT	PAPER NUMBER
2124	5

DATE MAILED: 12/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/756,019	DUESTERWALD ET AL.	
	Examiner	Art Unit	
	Trent J Roche	2124	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 January 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 January 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a)☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. Claim 2 recites the limitation "the terminating branch" in line 5. There is insufficient antecedent basis for this limitation in the claim. For purposes of examination this is interpreted to read "a terminating branch."

4. Claim 20 recites the limitation "the terminating branch" in line 5. There is insufficient antecedent basis for this limitation in the claim. For purposes of examination this is interpreted to read "a terminating branch."

5. Claim 21 recites the limitation "the terminating branch" in line 7. There is insufficient antecedent basis for this limitation in the claim. For purposes of examination this is interpreted to read "a terminating branch."

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 1-3, 5-8, 20 and 21 are rejected under 35 U.S.C. 102(a) as being anticipated by U.S. Patent 5,937,191 to Graham.

Regarding claim 1:

Graham teaches:

- a method for growing a hot trace in a program during the program's execution ("rearranging the instruction stream of basic blocks in hot traces will improve program execution..." in col. 5 lines 30-31.)
- in a dynamic translator ("translators such as compilers..." in col. 3 line 10)
- identifying an initial block ("a basic block begins with a label..." in col. 3 lines 25-26)
- growing the trace block-by-block by applying static branch prediction rules until an end-of-trace condition is reached ("rearranging the instruction stream of basic blocks in hot traces will improve program execution..." in col. 5 lines 30-31. For a trace to be performed, an end-of-trace condition would inherently be identified so that the trace eventually ends. Further, branch prediction is used in the arrangement, as seen in col. 6 lines 41-44, "the basic blocks of the program can be arranged so that the most frequent path taken at a conditional branch falls through to the next sequential basic block...")

as claimed.

Regarding claim 2:

Graham teaches:

- a method for growing a hot trace in a program during the program's execution ("rearranging the instruction stream of basic blocks in hot traces will improve program execution..." in col. 5 lines 30-31.)
- in a dynamic translator ("translators such as compilers..." in col. 3 line 10)
- identifying an initial block as the first block in a trace to be selected ("a basic block begins with a label..." in col. 3 lines 25-26)
- until an end-of-trace condition is reached, applying static branch prediction rules to a terminating branch of a last block in the trace to identify a next block to be added ("rearranging the instruction stream of basic blocks in hot traces will improve program execution..." in col. 5 lines 30-31. For a trace to be performed, an end-of-trace condition would inherently be identified so that the trace eventually ends. Further, branch prediction is used in the arrangement, as seen in col. 6 lines 41-44, "the basic blocks of the program can be arranged so that the most frequent path taken at a conditional branch falls through to the next sequential basic block...")
- adding the identified next block to the selected trace ("placing the source and destination blocks together." in col. 6 lines 48-49)

as claimed.

Regarding claim 3:

The rejection of claim 2 is incorporated, and further, Graham teaches storing the selected traces in a code cache ("reorganizing data structures of the program to reduce the data cache usage of the program in response to said program activity..." in col. 7 lines 21-23.)

Regarding claim 5:

The rejection of claim 2 is incorporated, and further, Graham teaches predicting the outcomes and targets of branches as claimed (Note col. 6 lines 41-49)

Regarding claim 6:

The rejection of claim 2 is incorporated, and further, Graham teaches maintaining execution counts for targets of branches as claimed ("by counting block arc transitions more accurate block execution count information can be obtained." in col. 4 lines 42-44)

Regarding claim 7:

The rejection of claim 2 is incorporated, and further, Graham teaches determining whether to add a target instruction to the hot trace as claimed ("so that the most frequent path taken at a conditional branch falls through to the next sequential basic block as opposed to jumping to a non-sequential successor block." in col. 6 lines 41-45)

Regarding claim 8:

The rejection of claim 7 is incorporated, and further, Graham teaches determining if the branch instruction is unconditional, and adding the target instruction of the branch instruction and the following instructions through the next branch to the hot trace as claimed ("unconditional branches from a source basic block to a destination basic block...can be removed by...placing the source and destination basic blocks together." in col. 6 lines 45-49)

Regarding claims 20 and 21:

Claims 20 and 21 are directed to a dynamic translator and a computer program product for performing the method of claim 2, and are rejected for the reasons set forth in connection with claim 2.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,937,191 to Graham in view of U.S. Patent 6,463,582 to Lethin et al.

Regarding claim 4:

The rejection of claim 2 is incorporated, and further, Graham does not teach end-of-trace conditions as claimed. Lethin et al teach in an analogous translation system the use of threshold conditions for determining what should be executed ("A variable threshold called the block picking threshold is used to select frequently executed blocks. If the execution probability of a block is larger than or equal to the threshold, then that block is considered frequently executed and it is translated. If the execution probability is below the threshold, then the block is considered infrequently executed and is not translated." in col. 59 lines 42-48). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the threshold conditions of Lethin et al with the optimization methods of Graham, enabled via the addition of instructional code, as

this would improve the likelihood of a higher probability of success of a branch prediction being accurate in the system disclosed by Graham.

10. Claims 9-12 and 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,937,191 to Graham in view of U.S. Patent 5,687,360 to Chang.

Regarding claim 9:

The rejection of claim 7 is incorporated, and further, Graham does not teach symbolically evaluating a branch condition as claimed. Chang teaches in an analogous system utilizing branch prediction a method of symbolically evaluating a branch condition ("Another static scheme predicts that certain types of branches (for example, jump-on-zero instructions) will always be Taken or Not Taken." in col. 2 lines 6-8). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the branch prediction method of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would further improve branch prediction accuracy, further improving optimizations in the system of Graham.

Regarding claim 10:

The rejection of claim 7 is incorporated, and further, Graham does not teach determining if a heuristic rule can be applied to a branch instruction as claimed. Chang teaches in an analogous system utilizing branch prediction heuristics the use of rules in predictions ("Another static scheme predicts that certain types of branches (for example, jump-on-zero instructions) will always be Taken

or Not Taken." in col. 2 lines 6-8). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the heuristic rule prediction method of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would further improve branch prediction accuracy, further improving optimizations in the system of Graham.

Regarding claim 11:

The rejection of claim 9 is incorporated, and further, Graham does not teach determining if a heuristic rule can be applied to a branch instruction as claimed. Chang teaches in an analogous system utilizing branch prediction heuristics the use of rules in predictions ("Another static scheme predicts that certain types of branches (for example, jump-on-zero instructions) will always be Taken or Not Taken." in col. 2 lines 6-8). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the heuristic rule prediction method of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would further improve branch prediction accuracy, further improving optimizations in the system of Graham.

Regarding claim 12:

The rejection of claim 10 is incorporated, and further, Graham does not teach determining whether a confidence counter has reached a threshold level as claimed. Chang teaches an analogous system utilizing branch prediction the use of a counter which has a threshold level ("if the count is greater than or equal to a predetermined threshold value..." in col.3 lines 47-48.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the threshold-

based counter of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would allow a user to specify the maximum number of times to take a certain branch in the system of Graham.

Regarding claim 16:

The rejection of claim 2 is incorporated, and further, Graham does not teach incrementing or decrementing based on which static branch prediction rule has been applied as claimed. Chang teaches an analogous system utilizing branch prediction a counter which increments or decrements based on prediction rules ("If the branch is Taken, the count for the branch sequence is incremented by one...otherwise the count is decremented by one." in col. 3 lines 53-56). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the counter of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would enable a user to accurately determine the total number of Taken branches to Not Taken branches, for use in further optimizing the system of Graham.

Regarding claim 17:

The rejection of claim 2 is incorporated, and further, Graham does not teach associating a different count with each different target instruction as claimed. Chang teaches an analogous system utilizing branch prediction a counter associated with teach branch instruction which increments or decrements based on prediction rules ("Because each branch instruction has its own array of counters..." in col. 3 lines 66-67. Further, "If the branch is Taken, the count for the branch sequence is incremented by one...otherwise the count is decremented by one." in col. 3 lines 53-56). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

use the multiple counters of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would enable a user to accurately determine specific instructions which require more optimization than others in the system of Graham.

Regarding claim 18:

The rejection of claim 17 is incorporated, and further, Graham does not teach the target instructions including backwards taken branches and exit branches as claimed. Chang teaches an analogous system utilizing branch prediction rules based on the direction of the branch ("Static schemes may also be based upon the direction of the branch, as in 'if the branch is backward, predict Taken, if forward, predict Not Taken.'" in col. 2 lines 9-11). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the branch prediction method of Chang with the program optimization methods of Graham, enabled via the addition of instructional code, as this would further improve branch prediction accuracy, further improving optimizations in the system of Graham.

Regarding claim 19:

The rejection of claim 2 is incorporated, and further, Graham does not teach wherein a total number of instructions exceeds a predetermined limit as claimed. Chang teaches an analogous system utilizing branch prediction the use of a counter which has a threshold level ("if the count is greater than or equal to a predetermined threshold value..." in col.3 lines 47-48.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the threshold-based counter of Chang with the program optimization methods of Graham, enabled via the

addition of instructional code, as this would allow a user to specify the maximum number of times to take a certain branch in the system of Graham.

11. Claims 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,937,191 to Graham in view of U.S. Patent 6,282,629 to Sager.

Regarding claim 13:

The rejection of claim 7 is incorporated, and further, Graham does not teach determining whether a branch instruction is a procedure return, and determining if a value in a link register has been modified as claimed. Sager teaches in an analogous branch prediction system the determination of whether an instruction is a procedure return and the use of a register ("When branch type 'Procedure Return' is coded, instead of using a fixed A address from the prediction store, we used the predicted return address from the stack..." in col. 19 lines 29-31). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the procedure return checking code of Sager with the program optimization methods of Graham, enabled via the addition of instructional code, as this would improve performance of the system disclosed by Graham by ensuring that values contained in any one of the registers which may be used by the set of instructions will not have changed before the trapped condition is recognized, as discussed in the background of Sager.

Regarding claim 15:

The rejection of claim 13 is incorporated, and further, note the rejection regarding claim 13.

12. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,937,191 to Graham in view of U.S. Patent 5,687,360 to Chang, further in view of U.S. Patent 6,282,629 to Sager.

Regarding claim 14:

The rejection of claim 11 is incorporated, and further, neither Graham nor Chang teach determining whether a branch instruction is a procedure return, and determining if a value in a link register has been modified as claimed. Sager teaches in an analogous branch prediction system the determination of whether an instruction is a procedure return and the use of a register ("When branch type 'Procedure Return' is coded, instead of using a fixed A address from the prediction store, we used the predicted return address from the stack..." in col. 19 lines 29-31). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the procedure return checking code of Sager with the program optimization methods of Graham, modified by Chang. This modification would be enabled by adding instructional code to the system of Graham, modified by Chang. One of ordinary skill in the art would be motivated to do this as this would improve performance of the system disclosed by Graham, modified by Chang, by ensuring that values contained in any one of the registers which may be used by the set of instructions will not have changed before the trapped condition is recognized, as discussed in the background of Sager.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trent J Roche whose telephone number is (703)305-4627. The examiner can normally be reached on Monday-Friday, 9:00 am - 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on (703)305-9662. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)305-3900.

Trent J Roche
Examiner
Art Unit 2124

TJR

ANTONY NGUYEN-BA
PRIMARY EXAMINER